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EARLY WINTER FOOD OF RUFFED GROUSE ON THE GEORGE WASHINGTON NATIONAL FOREST

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INTRODUCTION

The wildlife values of national-forest lands are each year being increasingly recognized, and as a consequence more and more effort is being directed to improving and maintaining suitable conditions on these lands for the various forest-inhabiting game species. Increased interest in the forest fauna makes it essential to have a detailed record of the local food habits of each kind of game, both as a basis for making improvements and as a guide for appraising and classifying lands as to their utility for specific game animals. The present study concerns the early winter food habits of the ruffed grouse (*Bonasa umbellus*) (fig. 1) on the George Washington National Forest, Va. and W. Va., one of the largest and potentially one of the most important forest-game areas in the East. The study is designed to aid forest officers in their correlation of wildlife work with forest management, and also to be of service to State game officials and to sportsmen and wildlife conservationists of the region concerned, all of whom

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² Special acknowledgement is made by the authors to Ray Greenfield and J. A. Bruce, who were appointed under Forest Service C. C. C. funds allotted to the Bureau of Biological Survey to assist in making the stomach examinations on which this report is based; and to A. C. Martin, of the Biological Survey, who identified many fragmentary food items.

are in need of information on the local food preferences and requirements of this outstanding game bird.

This circular provides basic data for a long-time grouse-management planning program for the George Washington Forest. The study upon which it is based is largely the outgrowth of a cooperative wildlife agreement between the Forest Service and the Bureau of Biological Survey similar to others in which the Survey assumes responsibility for fundamental research in wildlife management as it relates to lands that are federally owned or controlled. It is a direct development of a general wildlife survey made by the Biological Survey in the summer of 1935³ of the Big Levels Wildlife Refuge area of that forest, in which it was recommended that investigation be made of

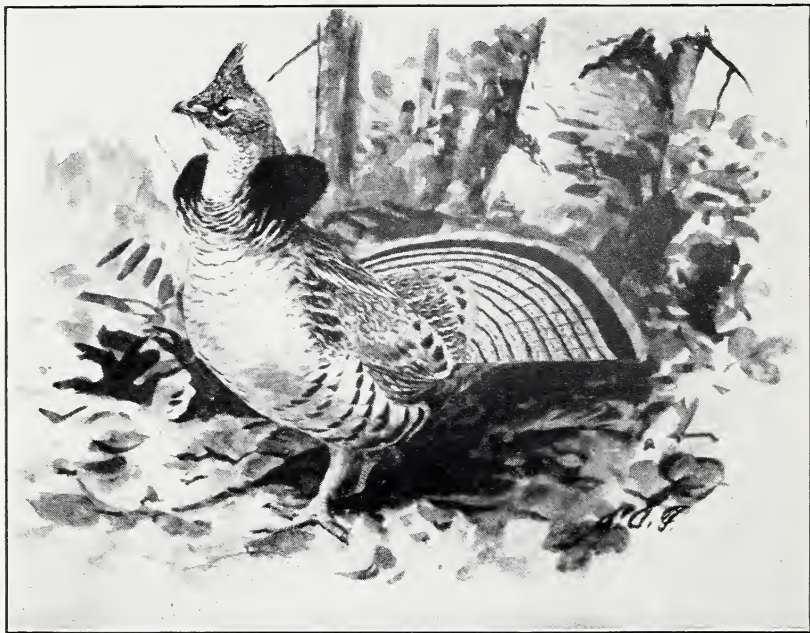


FIGURE 1.—Adult ruffed grouse (*Bonasa umbellus*).

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the food habits of the ruffed grouse on the forest in order that management plans for this species might be worked out on a sound basis.

Only the early part of the winter is covered in the report, since adequate material was available only for the months of November and December, the period in which the birds were legally hunted in 1935 and 1936. Most of the crops and gizzards studied were taken from birds killed by hunters. The later winter months and other seasons of the year will be covered by subsequent investigations. Stomach material for the out-of-season period will be accumulated, more slowly, of course, as only a few birds will be obtained each month. This report is presented in advance of completion of the project in order that what has now been learned may be made avail-

³ JACKSON, H. H. T., NELSON, A. L., and BAILEY, VERNON. CONSIDERATIONS FOR THE IMPROVEMENT OF GAME RESOURCES ON THE BIG LEVELS GAME REFUGE, AUCUSTA COUNTY, VA. Unpublished report, filed in the Biological Survey.

able and utilized in determining current forest game-management practices.

MATERIAL AVAILABLE

Since the food habits of birds and most other animals are best determined by examining their stomach contents, this method was followed in the present study. Complete food analyses were made of 184 crops and 107 gizzards of 185 ruffed grouse taken during November and December 1935 and 1936. In these examinations all food items were sorted out as to kind and grouped much as is shown in figure 2.



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FIGURE 2.—Crop contents of one ruffed grouse collected on the George Washington National Forest December 1935; the 30 food groups, each about $\times \frac{1}{2}$, were identified as follows: 1, *Menziesia pilosa*; 2, buds of pin cherry (*Prunus pensylvanica*); 3, seed of witch-hazel (*Hamamelis virginiana*); 4, buds of trailing-arbutus (*Epigaea repens*); 5, buds of hickory (*Carya* sp.); 6, buds of black gum, or tupelo (*Nyssa sylvatica*); 7, Canada hemlock (*Tsuga canadensis*); 8, serviceberry (*Amelanchier canadensis*); 9, rose family (Rosaceae); 10, buttercup (*Ranunculus* sp.); 11, Christmas fern (*Polystichum acrostichoides*); 12, panic grass (*Panicum* sp.); 13, leaves of wintergreen (*Gaultheria procumbens*); 14, fruit of wintergreen; 15, seed capsules of mountain-laurel (*Kalmia latifolia*); 16, moss (Musci); 17, bushclover (*Lespedeza* sp.); 18, buds of mountain-laurel; 19, undetermined leaf; 20, greenbrier (*Smilax* sp.); 21, oxalis (*Oxalis* sp.); 22, blueberry (*Vaccinium* sp.); 23, cinquefoil (*Potentilla* sp.); 24, partridgeberry (*Mitchella repens*); 25, stonecrop (*Sedum nevii*); 26, leaves of trailing-arbutus; 27, undetermined leaf; 28, selfheal (*Prunella vulgaris*); 29, aster (*Aster* sp.); 30, sheep sorrel (*Rumex acetosella*).

Measurements of the volume of each item were then made, and on the basis of these figures comparative percentages were calculated to show what each contributed to the total.

The material serving as a basis for the study came from various parts of the forest, principally from the Dry River ranger district, but good representations also came from the Lee and Deerfield districts. The collections were obtained by members of the Forest Service,

largely, as previously stated, from hunters through Civilian Conservation Corps enrollees stationed during the hunting season near the main entrances to the forest (fig. 3). Although the greater part of the stomachs came from Virginia, 18 were from birds shot in West Virginia (fig. 4).

To facilitate stomach examination, preliminary studies were made of the distribution and abundance of plants known to be used as food by the ruffed grouse. Collections of the more important species were made during these studies and photographs were taken of all that ranked high as a source of early winter food. They are illustrated herein to aid in field identification of outstanding early winter foods of the ruffed grouse on the George Washington Forest and



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FIGURE 3.—Collecting stations, with "Hunters Stop" road markers at approaches, were established by the Forest Service at main entrances to the forest, in order that crops and gizzards of ruffed grouse might be removed for study by the Biological Survey.

adjacent areas. They show the plants in their normal winter condition, which may often be quite different from the showy appearance of the same plants in summer.

PRESENT FOREST CONDITIONS

Approximately 91 percent of the George Washington National Forest has been cut over during the past 100 years. The present composition may be divided according to age classes as follows: Open land, 0.5 percent; 0 to 20 years, 26; 21 to 40 years, 49; 41 to 80 years, 12; 81 to 120 years, 3.5; 121 years or older, 9 percent. The forest type is commonly known as Appalachian hardwood. The stand consists largely of deciduous species with occasional patches of conifers. The elevation of the ridges is from 1,500 to 4,500 feet above sea level.

In many places there is little or no subsoil, the surface soil directly overlying bedrock. In some sections the slopes are covered with boulders or rock slides, and in others with numerous rock outcroppings

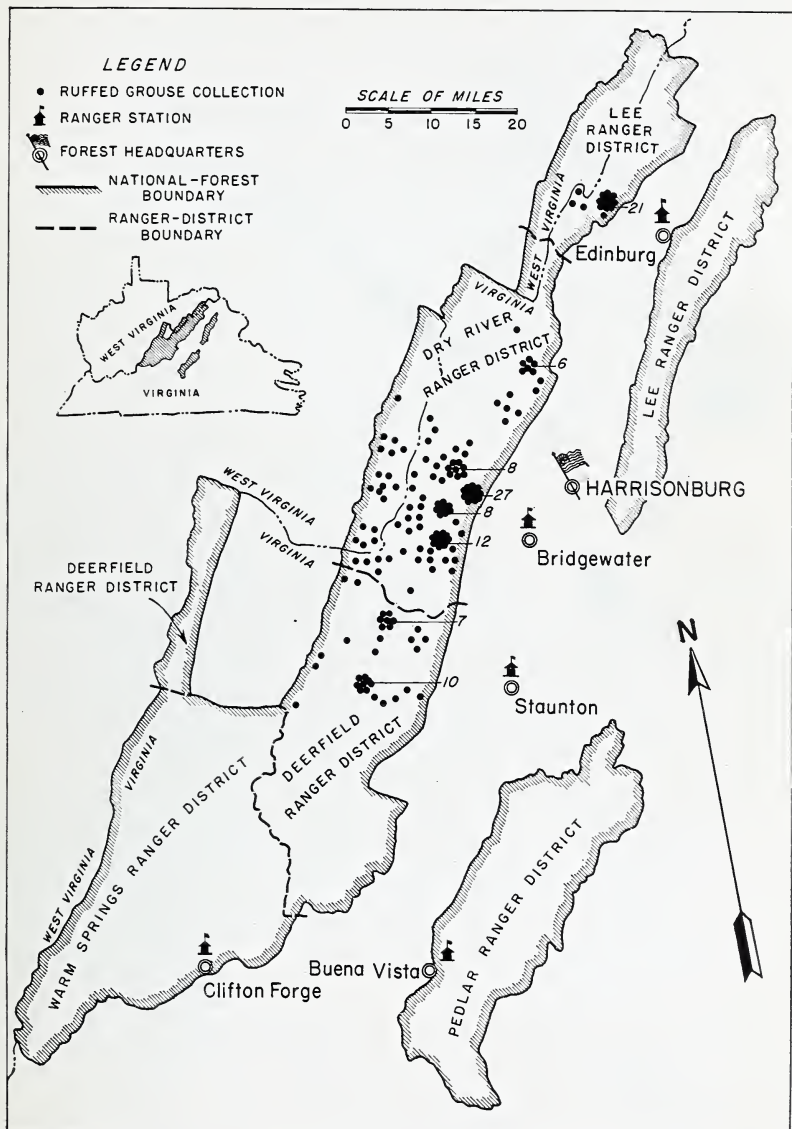


FIGURE 4.—Distribution of stomachs of 185 ruffed grouse collected in the various ranger districts of the George Washington National Forest, Va. and W. Va., in November and December of 1935 and 1936.

or ledges. The drier sites on the ridges are covered for the most part with bear oak and associated species, consisting of scarlet, black, red, and chestnut oaks, black locust, pitch, shortleaf and table mountain pines, and chinquapin. The dry slopes and flat ridges support

mixed stands of hardwoods, composed chiefly of chestnut oak, black and scarlet oaks, black gum, black locust, and shagbark and mockernut hickories.

The deep fertile soils, as found in coves on north slopes, support mixed stands of northern hardwoods, typical species being sugar maple, red maple, yellow birch, red and white oaks, basswood, black cherry, hemlock, and white pine.

THE 20 MOST IMPORTANT FOOD PLANTS

Although 98 foods are listed in table 1 as being utilized by grouse, only about a fifth of these are important from the standpoint of the bulk they contributed. Since availability is a major factor influencing selection, however, and since any number of factors are constantly operating to alter food conditions from year to year, some of the foods listed below the first 20 in table 1 might become important to the ruffed grouse or even a major source of its food in some areas.

TABLE 1.—*Early winter plant foods of ruffed grouse on the George Washington National Forest, based on examination of crops and gizzards of 185 birds, showing volume, frequency with which taken, and parts used*

Food	Volume in total food	Stomachs in which found	Parts used
	<i>Percent</i>	<i>Number</i>	
Greenbrier (<i>Smilax</i> spp.).....	16.29	110	Leaves and fruit.
Oak (<i>Quercus</i> spp.).....	10.62	56	Acorns and buds.
Grape (<i>Vitis</i> spp.).....	9.00	29	Fruit.
Mountain-laurel (<i>Kalmia latifolia</i>).....	7.85	89	Leaves, buds, and flower capsules.
Wintergreen (<i>Gaultheria procumbens</i>).....	6.11	71	Leaves and fruit.
Sheep sorrel (<i>Rumex acetosella</i>).....	4.85	54	Leaves.
Blueberry and huckleberry (<i>Vaccinium</i> spp. and <i>Gaylussacia</i> spp.).....	4.17	84	Buds and twigs.
Rose (<i>Rosa</i> spp.).....	3.85	74	Fruit.
Fern (principally <i>Polystichum acrostichoides</i>).....	3.54	46	Leaves.
Aster (<i>Aster</i> spp.).....	3.33	80	Do.
Viburnum (<i>Viburnum</i> spp., chiefly <i>V. prunifolium</i> and <i>V. acerifolium</i>).....	2.67	16	Fruit.
Pussytoes (<i>Antennaria</i> sp.).....	2.32	54	Leaves.
Partridgeberry (<i>Mitchella repens</i>).....	1.89	36	Fruit and leaves.
Sumac (<i>Rhus</i> spp.).....	1.39	19	Fruit.
Menziesia (<i>Menziesia pilosa</i>).....	1.31	42	Buds.
Hazelnut (<i>Corylus</i> spp.).....	1.22	17	Buds and catkins.
Trailing-arbutus (<i>Epigaea repens</i>).....	1.19	24	Flowers, buds, and leaves.
Serviceberry (<i>Amelanchier canadensis</i>).....	1.08	24	Buds.
Hawthorn (<i>Crataegus</i> sp.).....	1.06	20	Fruit.
Selfheal (<i>Prunella vulgaris</i>).....	.93	37	Leaves.
Rhododendron (<i>Rhododendron</i> sp.).....	.93	31	Buds.
Birch (<i>Betula</i> spp.).....	.92	21	Buds and catkins.
Hophornbeam (<i>Ostrya virginiana</i>).....	.85	7	Buds, catkins, and seeds.
Avens (<i>Geum</i> spp.).....	.80	23	Leaves and seeds.
Stonewort (<i>Sedum</i> spp.).....	.78	26	Leaves.
Hepatica (<i>Hepatica</i> spp.).....	.67	18	Do.
Grass (Gramineae).....	.49	55	Do.
Corn (<i>Zea mays</i>).....	.49	1	Seeds.
Clover (<i>Trifolium</i> spp.).....	.47	10	Leaves.
Alumroot (<i>Iteuchera</i> spp.).....	.46	12	Do.
Goldenrod (<i>Solidago</i> spp.).....	.44	22	Do.
Cinquefoil (<i>Potentilla</i> spp.).....	.43	55	Do.
Bramble (<i>Rubus</i> spp.).....	.41	22	Do.
Buttercup (<i>Ranunculus</i> spp.).....	.41	19	Do.
Apple (<i>Malus</i> spp.).....	.41	3	Buds.
Barren strawberry (<i>Waldsteinia fragarioides</i>).....	.34	4	Leaves.
Witch-hazel (<i>Hamamelis virginiana</i>).....	.32	41	Seeds, flowers, and buds.
Polygala (<i>Polygala</i> spp., chiefly <i>P. paucifolia</i>).....	.31	14	Leaves.
St. Johnswort (<i>Hypericum</i> spp.).....	.30	3	Do.
Dogwood (<i>Cornus</i> spp.).....	.28	40	Buds and seeds.
Plantain (<i>Plantago</i> spp.).....	.28	9	Leaves.
Holly (<i>Ilex</i> , deciduous species).....	.28	4	Fruit.
Bushclover (<i>Lespedeza</i> spp.).....	.27	28	Seeds and leaves.
Bedstraw (<i>Galium</i> spp.).....	.24	16	Do.

TABLE 1.—Early winter plant foods of ruffed grouse on the George Washington National Forest, based on examination of crops and gizzards of 185 birds, showing volume, frequency with which taken, and parts used—Continued

Food	Volume in total food	Stomachs in which found	Parts used
	Percent	Number	
Foamflower (<i>Tiarella</i> spp.)	0.23	8	Leaves.
Vetch (<i>Vicia</i> spp.)	.22	10	Do.
Speedwell (<i>Veronica</i> spp.)	.21	21	Do.
Wild carrot (<i>Daucus carota</i>)	.21	14	Do.
Maple (<i>Acer</i> spp.)	.19	25	Fruit and buds.
Black gum (<i>Nyssa sylvatica</i>)	.19	20	Do.
Virginia creeper (<i>Parthenocissus quinquefolia</i>)	.18	2	Fruit.
Elm (<i>Ulmus</i> spp.)	.16	2	Buds.
Dandelion (<i>Taraxacum</i> spp.)	.12	20	Leaves.
Hawkweed (<i>Hieracium</i> spp.)	.11	22	Do.
Saxifrage (<i>Saxifraga virginensis</i>)	.06	3	Do.
Everlasting (<i>Gnaphalium</i> sp.)	.05	2	Do.
Chokeberry (<i>Pyrus</i> spp.)	.05	2	Fruit.
Wildginger (<i>Asarum</i> sp.)	.05	1	Leaves.
Chickweed (<i>Stellaria media</i>)	.04	5	Do.
Thistle (<i>Cirsium</i> sp.)	.04	4	Do.
Heartleaf (<i>Ampelopsis cordata</i>)	.04	1	Fruit.
Spicebush (<i>Benzoin aestivale</i>)	.04	1	Buds and twigs.
Alder (<i>Alnus</i> sp.)	.04	2	Buds and catkins.
Strawberry (<i>Fragaria</i> sp.)	.03	10	Leaves.
Agrimony (<i>Agrimonia</i> sp.)	.03	2	Seeds.
Ticklelover (<i>Desmodium</i> sp.)	.03	2	Do.
Willow (<i>Salix</i> sp.)	.03	1	Leaves.
Black snakeroot (<i>Sanicula</i> sp.)	.03	1	Seeds.
Rhynchosia (<i>Rhynchosia</i> sp.)	.03	1	Do.
Horsenettle (<i>Solanum carolinense</i>)	.03	1	Fruit.
Bluet (<i>Houstonia</i> spp.)	.02	14	Leaves.
Sedge (principally <i>Carex</i> spp.)	.02	7	Do.
Evening-primrose (<i>Oenothera</i> sp.)	.02	6	Do.
Zizia (<i>Zizia cordata</i>)	.02	3	Do.
Meadowrue (<i>Thalictrum</i> sp.)	.02	2	Do.
Violet (<i>Viola</i> sp.)	.01	8	Leaves and seed capsules.
Fleabane (<i>Erigeron</i> spp.)	.01	8	Leaves.
Hickory (<i>Carya</i> spp.)	.01	4	Nuts.
Meadow-parsnip (<i>Thaspium barbinode</i>)	.01	3	Leaves.
Pyrola (<i>Pyrola</i> sp.)	.01	2	Do.
Cherry (<i>Prunus</i> spp.)	.01	2	Buds.
Groundsel (<i>Senecio</i> spp.)	.01	2	Leaves.
Chicory (<i>Cichorium intybus</i>)	.01	1	Do.
Deadnettle (<i>Lamium</i> sp.)	(1)	4	Do.
Hornbeam (<i>Carpinus caroliniana</i>)	(1)	3	Buds.
Eupatorium (<i>Eupatorium</i> sp.)	(1)	3	Leaves and seeds.
Jersey-tea (<i>Ceanothus americanus</i>)	(1)	2	Leaves.
Angelica (<i>Angelica villosa</i>)	(1)	2	Do.
Beebalm (<i>Monarda</i> sp.)	(1)	2	Do.
Beech (<i>Fagus grandifolia</i>)	(1)	1	Buds.
Peppergrass (<i>Lepidium virginicum</i>)	(1)	1	Leaves.
Black locust (<i>Robinia pseudoacacia</i>)	(1)	1	Seeds.
Mock pennyroyal (<i>Hedeoma</i> sp.)	(1)	1	Do.
Mint (<i>Mentha</i> sp.)	(1)	1	Do.
Cowwheat (<i>Melampyrum</i> sp.)	(1)	1	Do.
Japanese honeysuckle (<i>Lonicera japonica</i>)	(1)	1	Do.
Goldenstar (<i>Chrysogonum virginianum</i>)	(1)	1	Leaves.
Undetermined plants	1.06	68	Do.

¹ Trace.

The 20 choice and outstanding sources of early winter food, which together made up roughly 85 percent of the contents of the 185 stomachs analyzed, are here treated separately, in the order of their volumetric percentages, and their status defined in some detail.

GREENBRIER

Both the leaves and the fruits of the various greenbriers (*Smilax* spp.) are eaten extensively by ruffed grouse during fall and early winter. The saw brier (*S. glauca*) (fig. 5) is apparently one of the most abundant and important food species. The leaves and fruits of most kinds persist throughout the winter and consequently are avail-

able to the birds during the critical months of the year. The fact that the plant usually grows in dense thickets adds to its general value, as it provides not only food but also excellent protective cover. The most thrifty thickets are usually found in the more or less open bottom lands, where soil and moisture conditions are favorable. Though useful for cover, old thickets do not produce large quantities

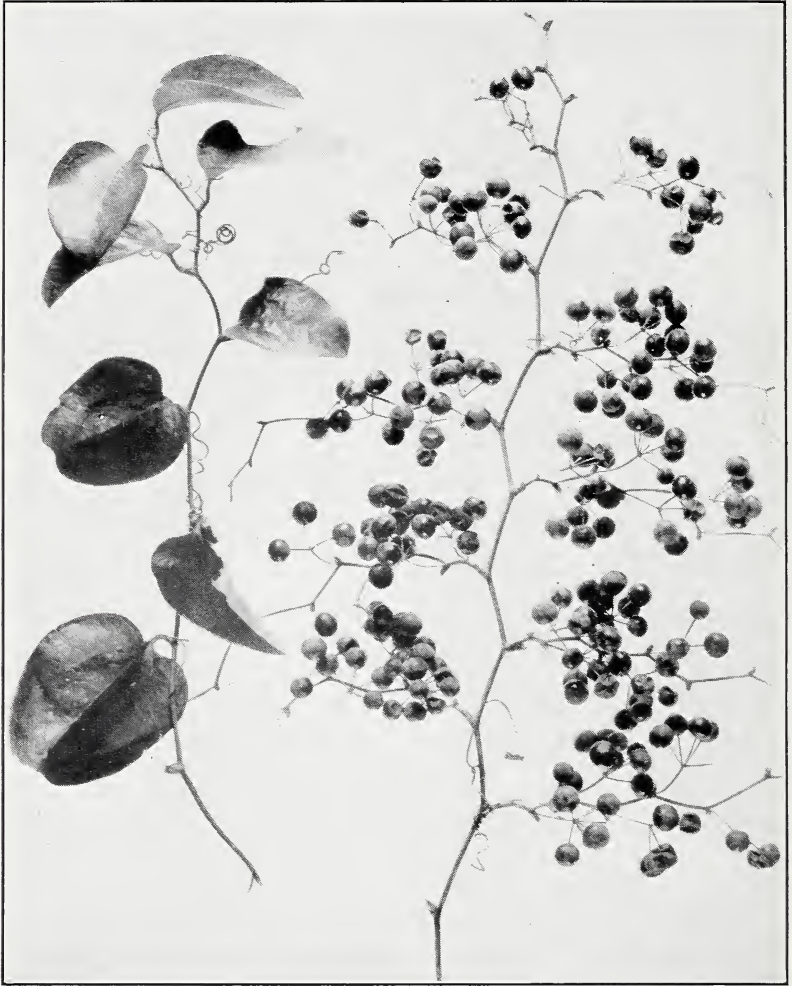


FIGURE 5.—Saw brier (*Smilax glauca*), $\times \frac{1}{2}$.

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of fruit, and, as the fruit is more frequently taken than the leaves, the younger growths are of greater food value.

OAK

Acorns might almost be considered the staff of life for game birds and game mammals. Although not so important to ruffed grouse as to some other species, oaks (*Quercus* spp.) nevertheless provide a

substantial source of food, not only in acorns, but also in the winter buds. Whether grouse show any preference as to species is not definitely known. The acorns of white oak (*Q. alba*) and bear oak (*Q. ilicifolia*) (fig. 6) have been positively identified in stomachs. The abundance and wide distribution of the bear oak on the ridges, combined with the fact that its acorns are small and readily eaten whole, should make this species potentially valuable as a seasonal source of grouse food. The ridges unfortunately are not inhabitable

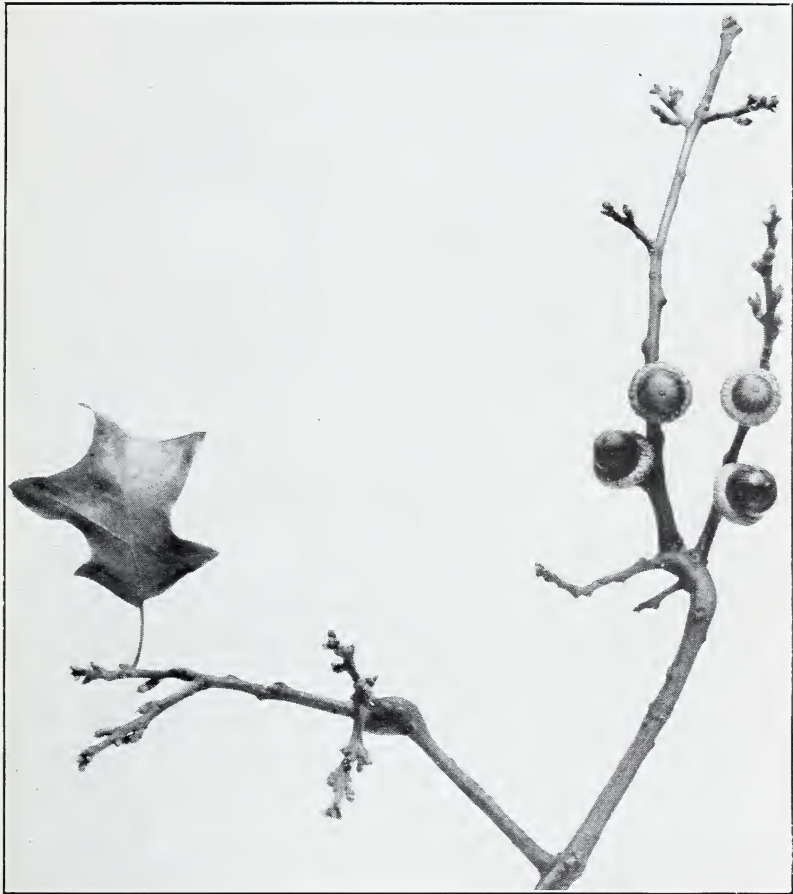


FIGURE 6.—Bear oak (*Quercus ilicifolia*), $\times \frac{3}{5}$.

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for grouse during severe weather, as the bleak winds, snow, and sleet drive the birds off into protected valleys, where they remain much of the time in winter. During fall and early winter, however, the ridges are accessible to grouse and temporarily provide important feeding environment.

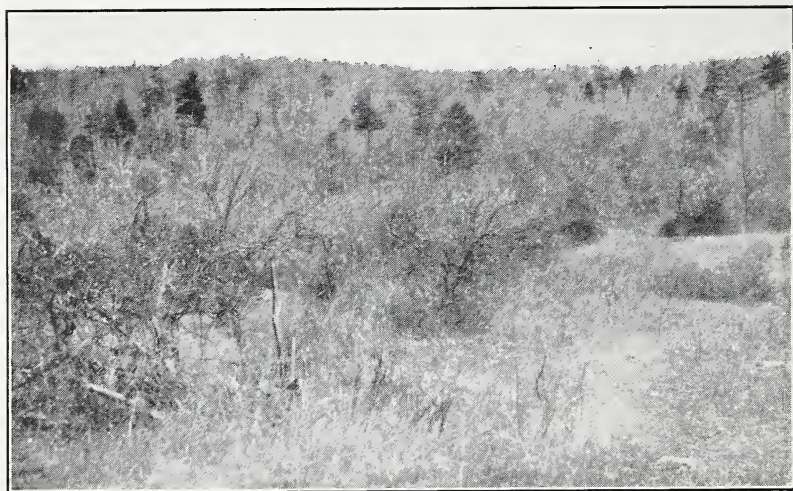
There is no indication that the extensive chestnut oak (*Q. montanus*) slopes (fig. 7) have any value as winter feeding grounds for grouse. Protective ground cover is generally deficient in these areas,

and the food present is not available for game. The mixed and open type of oak woodland on the better soils, having a good understory of young trees and shrubs and interspersed with cleared areas, are much more desirable environment for grouse (fig. 8).



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FIGURE 7.—The chestnut oak forest type on the poor soils that are characteristic of many ridge slopes is generally deficient in both food and cover for game birds.



B48878

FIGURE 8.—Old orchards within forest areas are a favorite habitat of ruffed grouse.

GRAPE

The fruits of the various species of grape (*Vitis*) (fig. 9) furnish an abundant supply of seasonal food to grouse. In some species they remain on the vines throughout December. That they are a favorite

food is indicated by the fact that at times they are taken to the exclusion of other foods, which for these birds is unusual (the average ruffed grouse meal consists of an assortment of foods rather than a single kind). Like the greenbriers, grapes frequently form dense thickets and so provide shelter as well as food. All species of grapes apparently are equally acceptable. The aromatically flavored frost grape (*V. cordifolia*) was taken a number of times, as was also the summer grape (*V. aestivalis*). Identification of the species in most instances, however, was not possible.

Grapes thrive best in open situations, where there is an abundance of light. Although present in shady woodlands, they do not produce heavy fruit crops there. In heavily wooded areas they usually make their way toward the light and develop a leafy growth only at the very



FIGURE 9.—Wild grape (*Vitis* sp.), $\times \frac{3}{4}$.

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tops of the trees. Such vines are not considered to be of any great value to grouse. The dense, low-growing canopy growths found in and around clearings and at the edges of roads are far more important for both food and cover. Where ruffed grouse and other game are important forest products, the development of grape thickets can well be a part of the forest game-management plan. Lopping over trees with established growths of grapes will help to provide improved food and cover conditions for ruffed grouse.

MOUNTAIN-LAUREL

The mountain-laurel (*Kalmia latifolia*) (fig. 10) is perhaps the most important cover for game on the forest, and it is significant that it also ranks high as a winter food for ruffed grouse. The leaves are frequently

eaten during both November and December and occasionally the buds and flower capsules also. Though the leaf is leathery and coarse in texture, it seems to be taken in distinct preference to many other more succulent forms of vegetation. The shrub tolerates shade and is able to survive under forest conditions long after many other food plants have died out. There is no evidence that mountain-laurel is toxic to grouse, though it is to domestic stock. As may be seen in table 1, about half the birds examined had eaten mountain-laurel to some extent.



FIGURE 10.—Mountain-laurel (*Kalmia latifolia*), $\times \frac{1}{2}$.

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WINTERGREEN

Found commonly growing in mountain-laurel thickets, it is not surprising that wintergreen (*Gaultheria procumbens*) (fig. 11) should be among the top five of the important winter foods of ruffed grouse on the forest. Both the tender red berries and the tasty evergreen leaves are consumed frequently and in considerable quantity during November and December. Growing as it does under various thickets of low-growing shrubs, wintergreen is ideal as a food from the standpoint of availability. Birds can feed on it and remain reasonably protected both summer and winter. Close association of food and cover is especially important to the birds during the hunting season. A total

of 109 grouse fed on mountain-laurel or wintergreen, and almost half of these, 51 in all, had taken both.

SHEEP SORREL

The leaves of the common sheep sorrel (*Rumex acetosella*) (fig. 12) are a favorite food of grouse. The plant occurs in a variety of situations but most commonly in and around fields and small cleared areas where the duff and litter of the forest floor does not interfere with its growth. Resistant to freezing, it remains green in sheltered areas



FIGURE 11.—Wintergreen (*Gaultheria procumbens*), $\times \frac{3}{4}$.

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throughout the winter. The most luxuriant growths occur in the bottom lands. Even during periods of heavy snows some of the plants are available as food, especially along protected stream banks, where small patches of ground are not infrequently exposed during the most severe winter weather.

BLUEBERRY AND HUCKLEBERRY

The buds and tender twigs of the two plant groups blueberries (*Vaccinium* spp.) (fig. 13) and huckleberries (*Gaylussacia* spp.) contribute a significant portion to the winter diet of grouse. Several species of each

grow on the George Washington Forest, but the most abundant is the low blueberry (*V. vacillans*). This is a widely distributed plant and a prolific fruit bearer. Along with other blueberries and huckleberries, it provides both summer and winter food for grouse. Perhaps no other



FIGURE 12.—Sheep sorrel (*Rumex acetosella*), $\times 1$.

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fruit-bearing shrub on this forest furnishes more seasonal food for wildlife in general than do these plant groups. Under free-use permits, local people gather large quantities of the berries each year, but only a small fraction of the total crop is removed in this way.



FIGURE 13.—Blueberry (*Vaccinium* sp.), $\times \frac{1}{5}$.

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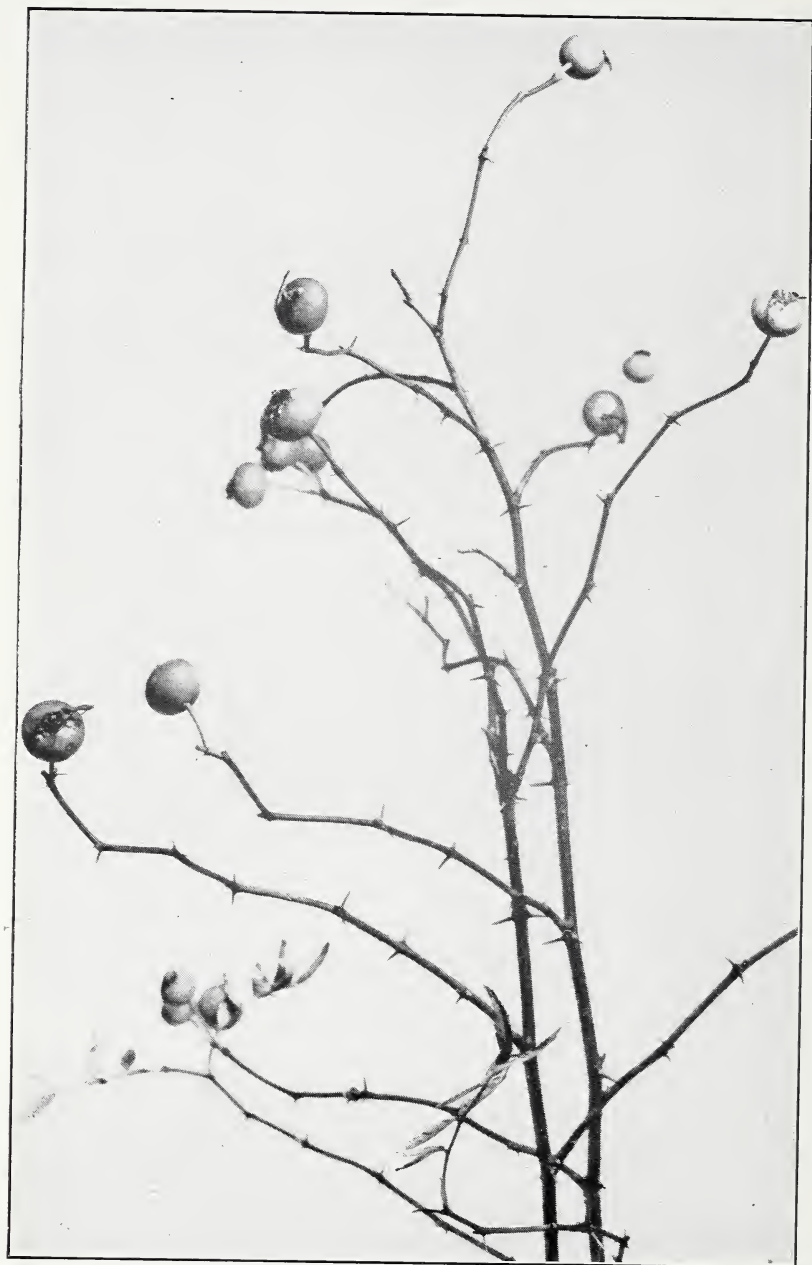


FIGURE 14.—Pasture rose (*Rosa carolina*), $\times \frac{1}{2}$.

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During all but the heaviest snows, the buds of blueberries and huckleberries are available and are probably all the more important for that reason, since they are accessible when many other favorite foods are buried. The present study does not cover the critical January-March period and therefore does not reveal the exact status of blueberry and huckleberry buds and twigs as grouse food during severe winter conditions. Furthermore, since State game regulations forbid the hunting of grouse in Virginia when snow is on the ground, there are no stomachs available in the present series to indicate food-habit trends under snow conditions. Because of the abundance and wide distribution of blueberries and huckleberries, however, it is believed that they are highly important as an all-around winter food. In mid-winter they probably are more important than here indicated for November and December.

ROSE

Though most fruits are available as bird food for only a comparatively short period, rose hips (*Rosa* spp.) are persistent and remain attached indefinitely. They furnish a quantity of food for grouse during November and December and are perhaps taken all winter, as the fruits are available throughout that season. The more prevalent pasture rose (*R. carolina*) (fig. 14) is no doubt the most important food species. The swamp rose (*R. palustris*) also is probably used, but it is not so abundant or so widely distributed as the pasture rose.

Roses are most thrifty in areas where they have an abundance of light. They may be expected to produce good crops of fruit, therefore, only when growing in or at the edge of open fields or clearings. Because of their value as a game food, and the fact that their fruits continue to be available even when snow is on the ground, roses can well be included in any planting program for improvement of ruffed grouse food resources.

FERN

Among the groups of lower plants, ferns (*Polystichum* et al.) are not generally thought of as having any value as food for game, except possibly as browse for deer. The record shows clearly, however, their importance in the diet of ruffed grouse on the George Washington Forest. First in rank, the evergreen Christmas fern (*P. acrostichoides*) (fig. 15) occurred in various quantities in 27 different grouse meals. Other species of ferns found to be eaten include polypody (*Polypodium virginianum*), bracken (*Pteridium latiusculum*), spleenwort (*Asplenium platyneuron*), wood fern (*Dryopteris spinulosa*), and moonwort (*Botrychium* sp.). The Christmas fern occurs most commonly in the richer wooded areas of the bottom land. It apparently thrives especially well along the wooded banks of streams, situations in which grouse habitually feed during the winter months.

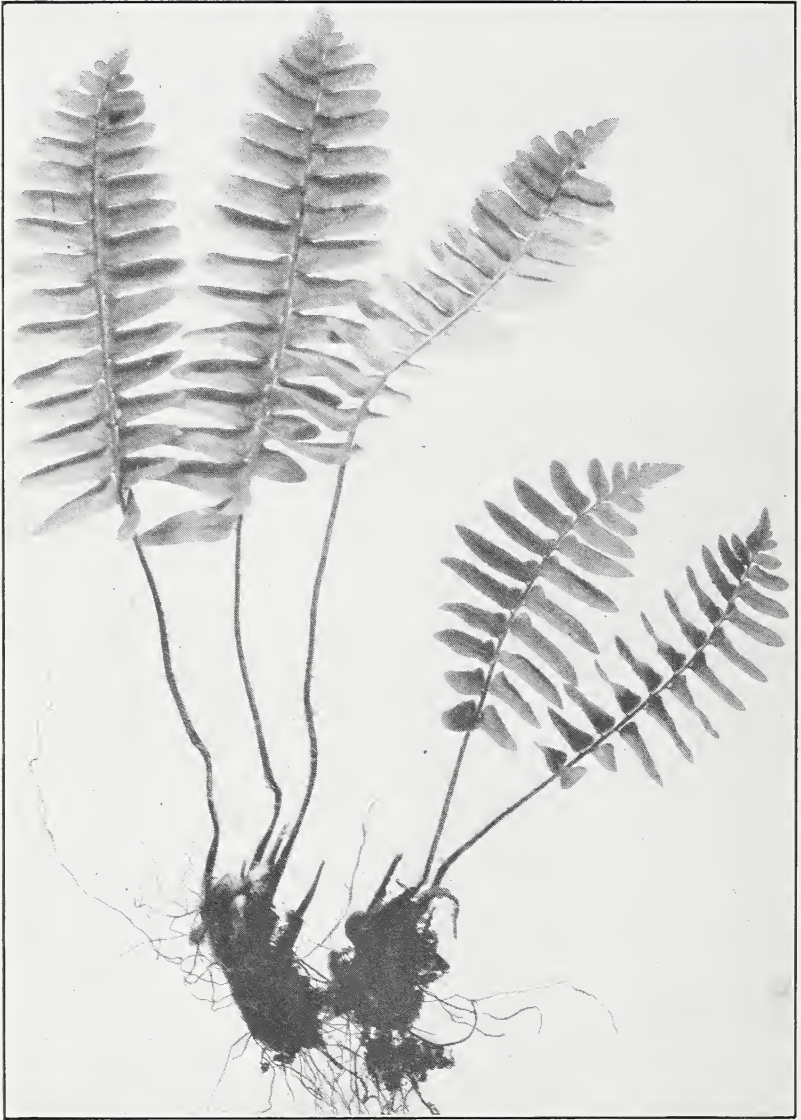


FIGURE 15.—Christmas fern (*Polystichum acrostichoides*), $\times \frac{2}{3}$.

B7246M

ASTER

In fall many species of aster (*Aster*) (fig. 16) form a basal cluster of leaves that persist through the winter; these leaves are taken frequently by grouse. A large number of species occur in this forest and so far as known all are equally acceptable. Although some thrive in woodlands, the field forms are the most conspicuous and abundant. Small roadside clearings and old abandoned fields produce large quantities of this type of food. The asters are among grouse foods that are taken frequently but in relatively small quantity. They rarely constitute more than a tenth of a meal, although they are a part of many and in frequency rank near the top.



FIGURE 16.—Aster (*Aster* sp.) $\times \frac{2}{3}$.

B7258M

VIBURNUM

The fruits of the viburnums (*Viburnum* spp.) are an important source of grouse food. They are taken in quantity and not infrequently constitute the major portion of a meal. Several species occur in this forest, but the blackhaw (*V. prunifolium*) and the mapleleaf viburnum (*V. acerifolium*) (fig. 17) are apparently the most important. Both grow in dry situations. As a supplement to the grapes and other vines and shrubs that are subject to wide fluctuations in fruit production, the viburnums fill an important niche in the grouse-food cycle. They are not especially abundant anywhere in this forest and generally have a scattered distribution.



FIGURE 17.—Mapleleaf viburnum (*Viburnum acerifolium*), $\times 1$.

B6997M

PUSSYTOES

The woolly, pale-green leaves of pussytoes (*Antennaria* sp.) (fig. 18) are of frequent occurrence in the food of the grouse. There are several species present in this forest, but all have quite similar habits of growth and probably are of equal value as food. The group is widely distributed and abundantly represented in practically all old clearings and in the more open spots where there is not too great an accumulation of leaf debris. Although recorded previously as being of value to grouse in other areas, this is the first study in which the plant has been



FIGURE 18.—Pussytoes (*Antennaria* sp.), $\times 3/4$.

E7233M

found among the bird's more important winter foods. Pussytoes occurred in the crops and gizzards of more than a fourth of the birds examined and frequently constituted a third of a meal.

PARTRIDGEBERRY

The value of the partridgeberry (*Mitchella repens*) (fig. 19) as a food for ruffed grouse is clearly implied in its name. The plant is well known locally and its presence in the crops of grouse has probably been detected by hunters many times. The bright red berries and the

evergreen leaves are available throughout the winter, and both are eaten. The fruits are rather tasteless, but this seems to be no factor in their edibility, so far as grouse are concerned. Growing as it does in heavily shaded areas, often under the dense shade of coniferous



FIGURE 19.—Partridgeberry (*Mitchella repens*), $\times \frac{3}{5}$.

B7240M

trees, the partridgeberry occurs where other select grouse foods are largely absent. It is, for instance, among the few food plants that thrive under the dense shade of hemlock (*Tsuga canadensis*). In general, it prefers heavy shade and a light humus soil.



FIGURE 20.—Smooth sumac (*Rhus glabra*), $\times \frac{3}{4}$.

B6896M

SUMAC

Three species of sumac (*Rhus*) occur in the George Washington Forest, staghorn (*R. typhina*), smooth (*R. glabra*) (fig. 20), and dwarf sumac (*R. copallina*). For successful growth all are restricted to field habitats and soon die out where topped by deciduous trees. They grow commonly at the edges of clearings and along fence rows and hedges. The crimson-colored mildly acid fruits are readily taken by grouse. The seeds, which are hard and apparently slow to digest, do not appear to be especially nourishing. The fact that they are used regularly and at times in considerable bulk, even in the presence of other choice foods, would indicate nevertheless that they are taken perhaps for some needed element in their sourish coatings, or for their abrasive quality as a supplement to gravel, and not necessarily for their food value.

MENZIESIA

The low-growing menziesia (*Menziesia pilosa*) (fig. 21), commonly found associated with mountain-laurel, and a relative of that plant, is an important source of winter food for grouse. Unlike the mountain-laurel, menziesia sheds all its leaves in fall, and only the buds are available as winter food. Although not well known, the shrub is nevertheless an abundant and widely distributed species in this forest. When the more favorite and succulent foods are buried under blankets of snow, ruffed grouse no doubt make considerable use of it.

HAZELNUT

The hazelnut (*Corylus* spp.) (fig. 22) is one of the more important of the shrubs supplying grouse food in this forest. Both buds and catkins are used in about equal quantity. Although widely distributed over the forest, the plant is not especially abundant anywhere. It is restricted by its habits of growth largely to fields and woods margins.

TRAILING-ARBUTUS

The trailing-arbutus (*Epigaea repens*) (fig. 23), one of the earliest of spring-flowering plants and also one of the most widely known, is a frequent source of winter food for grouse. The tender flower buds are of principal importance, but the rough, hairy leaves, although not at all succulent, are utilized to some extent. Tolerating shade, the plant grows well in dense woods. It requires a habitat similar to that of winter-green and partridgeberry and is not uncommonly found growing with them.



FIGURE 21.—*Menziesia* (*Menziesia pilosa*), $\times 1$.

B7254M



FIGURE 22.—Hazelnut (*Corylus* sp.), $\times \frac{1}{2}$.

B6904M

SERVICEBERRY

Amelanchier canadensis (fig. 24) is the most important species of serviceberry, or juneberry, that grows in this forest. One of the earliest shrubs to flower, its snow-white bloom is the most conspicuous sign of spring. Here it grows in the rather dry, open woodlands, and, although not a dominant shrub anywhere, it has a wide distribution. The fruits are available for only a comparatively short period early



FIGURE 23.—Trailing-arbutus (*Epigaea repens*), $\times \frac{2}{3}$.

B7242M

in summer, as they readily drop off when ripe and decay rapidly. They do not, therefore, appear in the winter diet of the grouse. The elongated, sharp, pointed buds and the tender twigs of the serviceberry are the source of the food it provides during this season and are taken with considerable regularity. The importance of the shrub is probably greatest during the snowy season, when grouse frequently are forced off a considerable part of their herbaceous diet because of the inaccessibility of the greens they normally eat.

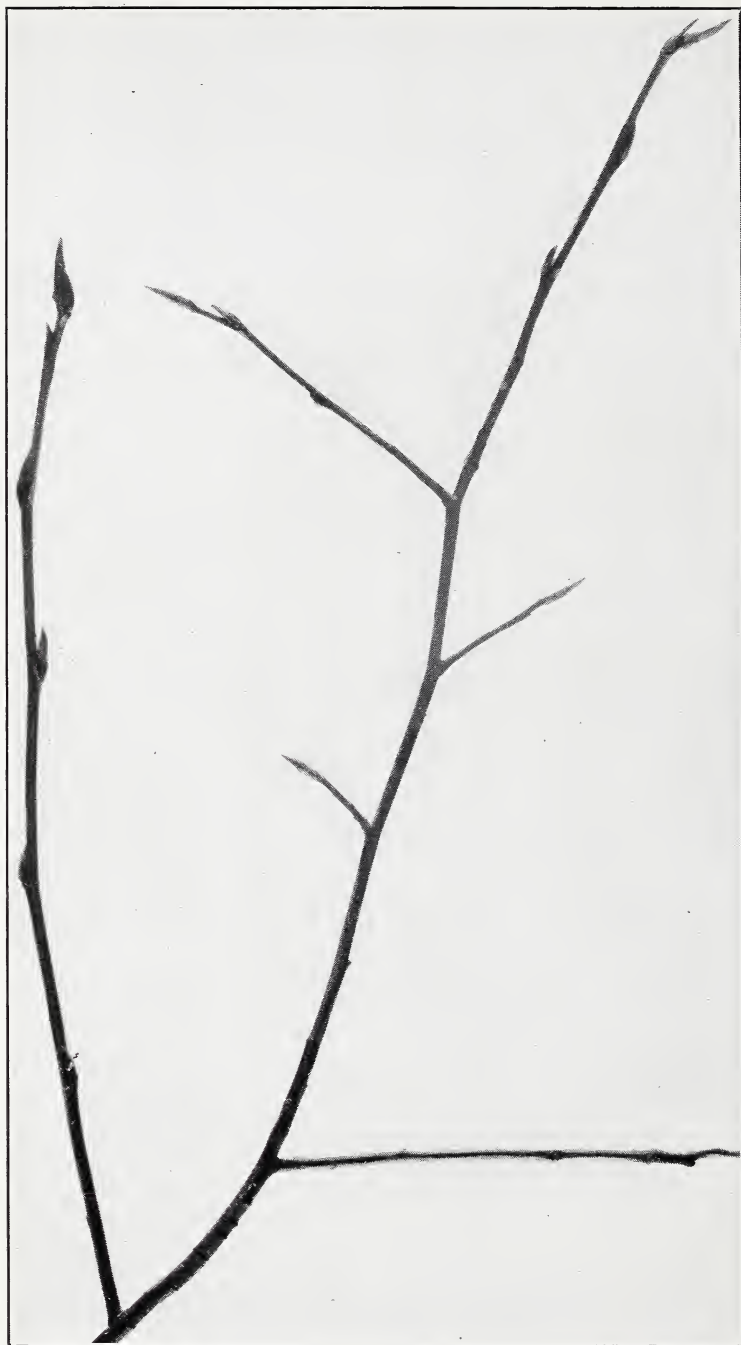


FIGURE 24.—Serviceberry (*Amelanchier canadensis*), $\times \frac{3}{4}$.

B7237M

HAWTHORN

Several closely related species of hawthorn (*Crataegus*) (fig. 25) occur in this forest, and so far as known all are equally acceptable as food for ruffed grouse. Apparently only the fruits are taken, there being no record of buds in any of the stomachs examined. Whether the twigs are too tough to be removed easily or whether the buds

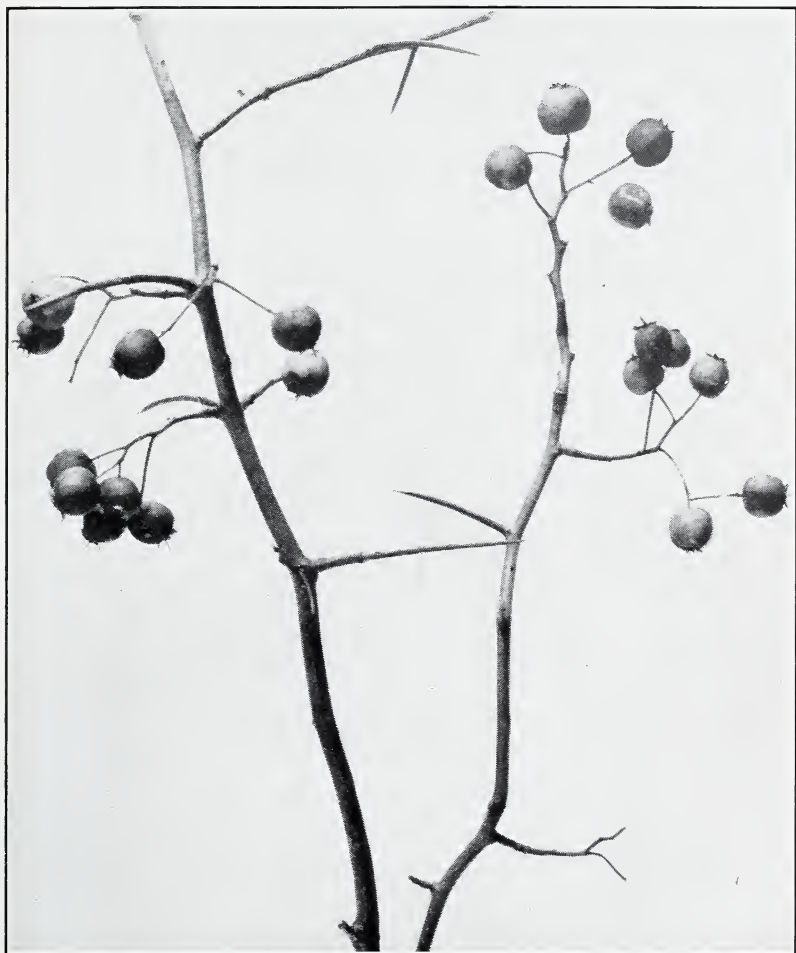


FIGURE 25.—Hawthorn (*Crataegus* sp.), $\times \frac{3}{4}$.

B6895M

themselves are too small or lack some characteristic to make them acceptable to grouse is not known. Nevertheless, the haws constitute a significant source of winter food, since they frequently persist into the winter. Local hawthorns are decidedly partial to open situations and do not tolerate shade to any great extent.



FIGURE 26.—Selfheal (*Prunella vulgaris*), $\times \frac{2}{3}$.

B7250M

SELFHEAL

In fall the selfheal (*Prunella vulgaris*) (fig. 26), like asters and many other perennials, produces a rosette of basal leaves that persist through the winter and, as they are of a succulent type, are frequently included in the early winter food of grouse. The plant grows in both fields and open woodlands. It is the only member of the mint family that was utilized by grouse to any significant extent. The leaves of a number of other species were represented, some of them of the odorous type, but they were taken only in small quantity and on few occasions.

TABLE 2.—Shade tolerance of plants on the George Washington National Forest used for food by ruffed grouse ¹

[Scientific names in table 1]

Species	Open situations ²	Moderate shade ³	Closed-canopy deciduous forest ⁴	Species	Open situations ²	Moderate shade ³	Closed-canopy deciduous forest ⁴
Sheep sorrel.....	x			Japanese honeysuckle.....	x	x	
Rose.....	x			Eupatorium.....	x	x	
Pussytoes.....	x			Goldenstar.....	x	x	
Sumac.....	x			Blueberry.....	x	x	
Hazelnut.....	x			Chokeberry.....	x	x	
Hawthorn.....	x			Serviceberry.....		x	
Grass.....	x			Stoncrop.....		x	
Corn.....	x			Alumroot.....		x	
Clover.....	x			Barren strawberry.....		x	
Cinquefoil.....	x			Dogwood.....		x	
Apple.....	x			Saxifrage.....		x	
Bramble.....	x			Heartleaf.....		x	
St. Johnswort.....	x			Black snakeroot.....		x	
Plantain.....	x			Zizia.....		x	
Wild carrot.....	x			Pyrola.....		x	
Dandelion.....	x			Meadow-parsnip.....		x	
Everlasting.....	x			Groundsel.....		x	
Thistle.....	x			Jersey-tea.....		x	
Strawberry.....	x			Angelica.....		x	
Willow.....	x			Mock pennyroyal.....		x	
Horsenettle.....	x			Cowwheat.....		x	
Evening-primrose.....	x			Mountain-laurel.....		x	x
Fleabane.....	x			Wintergreen.....		x	x
Chicory.....	x			Huckleberry.....		x	x
Peppergrass.....	x			Fern (chiefly Christmas fern).		x	x
Deadnettle.....	x			Viburnum (chiefly <i>V. prunifolium</i> and <i>V. acerifolium</i>).		x	x
Mint.....	x			Partridgeberry.....		x	x
Greenbrier (chiefly <i>Smilax glauca</i>).	x	x		Menziesia.....		x	x
Grape.....	x	x		Trailing-arbutus.....		x	x
Aster.....	x	x		Witch-hazel.....		x	x
Selfheal.....	x	x		Polygala (chiefly <i>P. paucifolia</i>).		x	x
Avens.....	x	x		Bedstraw.....		x	x
Goldenrod.....	x	x		Foamflower.....		x	x
Buttercup.....	x	x		Birch.....			x
Holly (<i>Ilex verticillata</i> and <i>I. monticola</i>).	x	x		Hophornbeam.....			x
Bushclover.....	x	x		Rhododendron.....			x
Vetch.....	x	x		Hepatica.....			x
Speedwell.....	x	x		Wildginger.....			x
Virginia creeper.....	x	x		Spicebush.....			x
Hawkweed.....	x	x		Maple.....			x
Chickweed.....	x	x		Sedge (principally <i>Carex</i> spp.).	x	x	x
Alder.....	x	x		Oak.....	x	x	x
Agrimony.....	x	x		Black gum.....	x	x	x
Tickclover.....	x	x		Elm.....	x	x	x
Rhynchosia.....	x	x		Hickory.....	x	x	x
Bluet.....	x	x		Hornbeam.....	x	x	x
Meadowrue.....	x	x		Beech.....	x	x	x
Violet.....	x	x					
Cherry.....	x	x					
Black locust.....	x	x					
Beebalm.....	x	x					

¹ Species listed in all 3 shade categories are treated only under the third group in the percentage computations in figures 27 and 28. The classifications as to shade tolerance do not apply to all areas but to conditions such as those in the locality studied, where the soil on some of the rocky slopes is thin and the forest stand less dense than in more fertile situations.

² Open situations include fields, fence rows, hedges, woods margins, and woods openings.

³ Moderate shade as found in mostly open woods.

⁴ The closed-canopy deciduous forest includes also conditions found in thickets of shrubs.

HABITATS PRODUCTIVE OF FOOD PLANTS

Some indication of the types of situations in this forest that are the greatest producers of ruffed grouse foods may be gained by an analysis of the data in table 1. Compilation of the percentage figures shows that herbaceous plants constitute approximately 33 percent of the bulk of the early winter food; shrubs, 25; vines, 26; and trees, 15 percent.

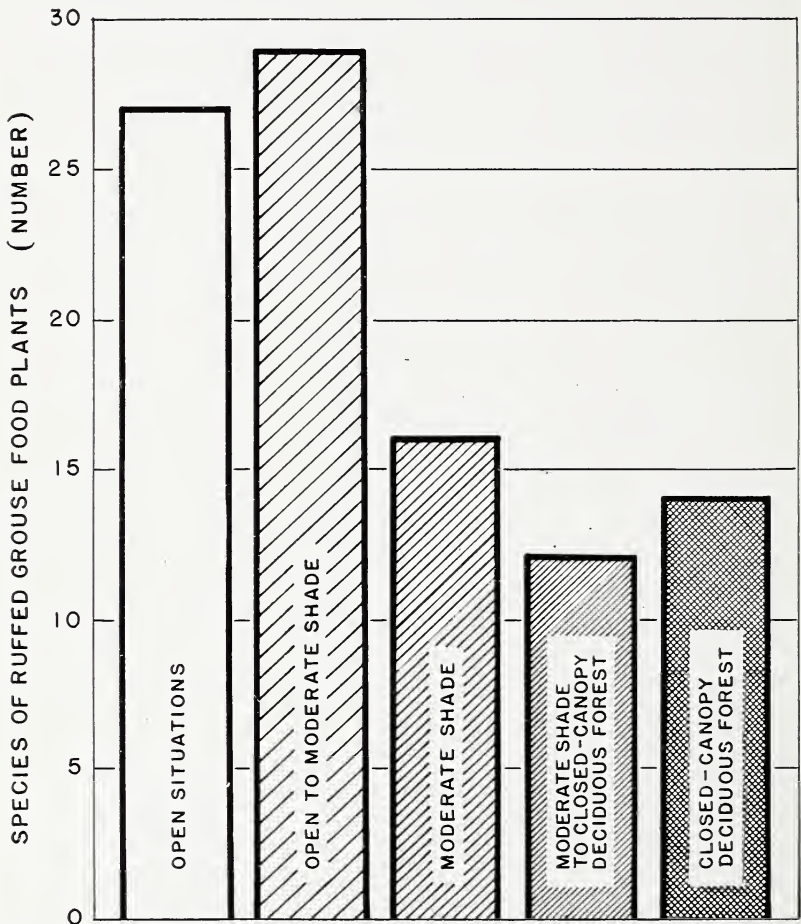


FIGURE 27.—Graphic summary of data in table 2, showing the number of species of ruffed grouse food plants living under various light conditions and indicating that fewer varieties of foods grow in the closed-canopy deciduous forest than in the more open situations.

Although some of the herbs, shrubs, and vines utilized are tolerant of moderately dense shade, as may be seen by the summary, in table 2, of shade tolerance of plants used for food by ruffed grouse, the majority are restricted by growth habit to the more open type of forest and to cleared spots within the forest proper (fig. 27). This is significant and emphasizes the fact that wooded areas with open canopies and sufficiently productive soils for the growth of good stands of mixed shrubs and vine thickets are the best feeding grounds for grouse.

Several of the herbaceous plants, including wintergreen,⁴ polygala (chiefly *P. paucifolia*), trailing-arbutus,⁴ partridgeberry, and many of the ferns, tolerate considerable shade and in this forest are largely restricted to shady places. Most of the herbs used as food by grouse, however, do not tolerate dense shade and cannot long survive in the heavy duff so common on the floor of the closed-canopy forest. Sheep

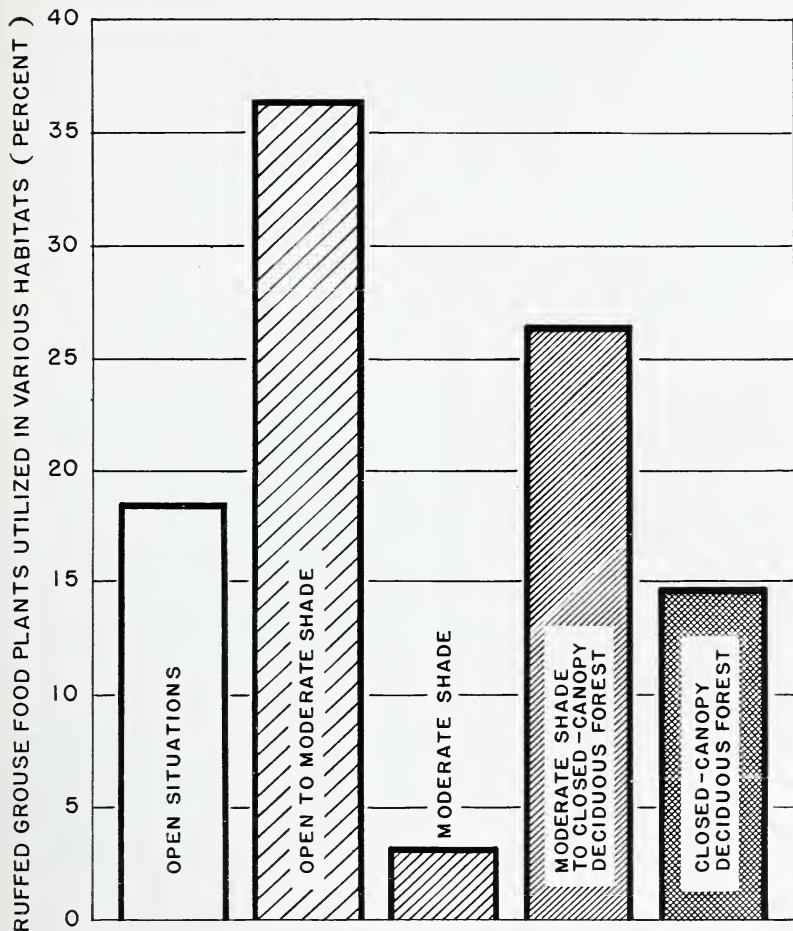


FIGURE 28.—Graphic summary of data in tables 1 and 2, showing percentage of ruffed grouse food obtained from various forest habitats, classified on the basis of shade density. (The difference between the total percentage shown in the graph and 100 percent consisted of undetermined plants and miscellaneous animal foods.)

sorrel, pussytoes, selfheal, avens, cinquefoil, and many of the asters are most successful in and around small glades, along forest roadways, and in old abandoned fields and on the borders of streams. These types require exposed mineral soil for survival.

Some of the food-producing shrubs, including the mountain-laurel, menziesia, and rhododendron, are partial to shaded or semishaded

⁴ Although wintergreen and trailing-arbutus are slightly woody, they are strictly low-growing plants and are here grouped with herbaceous species.

situations, but many other shrub foods are confined largely to the open woods or to old fields. Roses, blueberries, huckleberries, sumacs, hazelnuts, serviceberries, and deciduous hollies are in this group.

All the vines supplying food have high light requirements. Green-brier, especially the much-used saw brier (*Smilax glauca*), grapes, Virginia creeper, and bramble all do best in open or semiopen situations. A few of them do grow in densely shaded situations, but they do not produce large fruit crops there. Most of the food trees compete successfully for existence in the closed-canopy forest, although a few, including the apple, hawthorn, and flowering dogwood, are strictly open-forest or field inhabitants.

Tabulation of the complete food list on the basis of shade tolerance (table 2) shows that about 25 percent of the food species studied have low enough light requirements to grow under conditions present in the closed-canopy deciduous woodland of the George Washington Forest. The remaining 75 percent are, in the main, restricted by growth requirements to the open woods and to fields, small glades, and other similar situations within this forest. Plants of this latter group have higher light requirements and, in general, are not tolerant of the duff and leaf-litter composition typical of the floor of the closed type of forest.

The relative importance, or food value, in this forest of the species growing in the open or semiopen situations, as compared with those growing in the closed-canopy deciduous forest, has been clearly brought out in compiling the data in tables 1 and 2. Summary of these data (fig. 28) shows that the plants needing direct sunlight made up 19 percent of the total food; those growing in direct sunlight to moderate shade, 36 percent; those in moderate shade, 3 percent; moderate shade to closed-canopy deciduous forest, 26 percent; and closed-canopy deciduous forest, 15 percent. By direct comparison (figs. 27 and 28) it may be seen that while the closed-canopy deciduous forest could have harbored up to 25 percent of the total number of food species recorded in this investigation, a considerably larger proportion of the total food eaten could have been derived from this type of environment. The graph shows that 15 to 41 percent of the food could have come from this type. Because of the preference ruffed grouse show for the more open situations in this forest, it is reasonable to believe, however, that the quantity of food actually derived from this type of habitat does not approach the larger of these figures. It would more likely be closer to an average of the two, or about 28 percent.

These data indicate that a variety of forest conditions go to make up a suitable feeding environment for ruffed grouse. They show that the various environmental types from the closed-canopy deciduous forest condition to the open field are all integral parts of the ruffed grouse habitat, and thereby bring out clearly the need for maintenance of diversified forest conditions in areas where these birds are to be encouraged.

The data here presented are based on stomach material collected under snowless conditions, so that wide selections in food were available to the birds. The food situation in severe winter weather is probably different; certainly, many of the herbaceous foods would

not be so available, and consequently the general range of the diet would be more restricted.

FOOD VARIETY IN INDIVIDUAL MEALS

It is uncommon for a ruffed grouse to partake entirely of a single food at a meal—frequently, on the contrary, as many as 20 to 30 different items are represented in one feeding. The average number for the 185 meals here reported on was 10. The items are usually selected from a variety of food types, and a single meal may contain green-leaf material, considerable fruit, some buds, twigs, or catkins, a small fraction of mast, and a few dry seeds. No doubt, each of these classes of food contributes to some important dietary requirement of the species. The combination of fruits, leaves, and browse (buds, twigs, and catkins) is certainly an important one, since more than 65 percent of the meals studied contained all three of these types. Greens apparently are seldom omitted from a meal, as 90 percent of the stomachs contained one or more representatives of such food; fruit in some form occurred in 77 percent of the stomachs; and buds, twigs, or catkins were present in 71 percent.

QUANTITY OF FOOD EATEN

Like other gallinaceous birds, the ruffed grouse has a relatively high food capacity. The crop is an expanding organ and will hold several times as much food as the gizzard. The maximum volume of crop contents recorded in the present study was 118.5 cc, which is roughly equivalent to half the volume of an ordinary water glass. The maximum food volume recorded for gizzards was 20.5 cc, or approximately one-sixth of the largest crop volume. Extremely full crops and gizzards were infrequent. The average food volume of crops was 24 cc, and of gizzards 10.2 cc. As a rule, in the unusually well-filled crops fruit predominated.

ANIMAL FOOD

Adult grouse do not utilize insect or other animal food to any appreciable extent in winter. They do, however, take in small quantity a considerable variety of forms, including grasshoppers, crickets, bugs, flies, beetles, moths, small insect galls, spiders, centipedes, and earthworms. The contribution of these to the total food in this study was very slight, only 0.07 percent.

GRAVEL CONSUMPTION

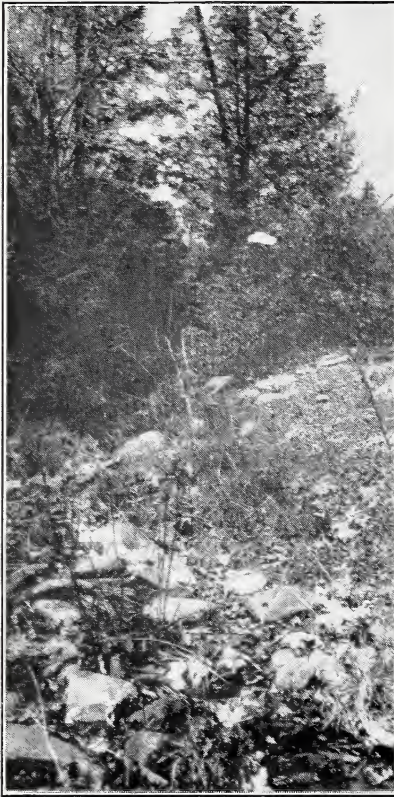
Gravel plays an important role in the digestive processes of the ruffed grouse just as it does in other gallinaceous birds. As a grinding agent, to supplement the strong muscular movements of the gizzard, it helps reduce food material into finely divided particles preparatory to its passage into the intestine. How much gravel is needed for this function depends on a variety of conditions, including the nature of the food eaten. In the 107 gizzards analyzed, 76 contained measurable quantities of pebbly rock material. The average per stomach was 0.8 cc, which is equivalent to about one-third of a teaspoon. In almost all cases the gravel was supplemented by hard, digestion-resisting seeds, many kinds of which no doubt are retained in the gizzard for their abrasive action until they are worn to fragments.

The number of gizzards containing no gravel—24 in all—suggests that not infrequently hard seeds serve as the sole grinding agent. These 24 gizzards were well supplied with seeds of rose (in 18), smilax (in 17), sumac, dogwood, witch-hazel, or black gum, all of which were frequently noted to be in different stages of wear. Gizzards with less than the average quantity of gravel content—0.8 cc—showed a higher content of hard seeds than those that were above average in the supply of grit. Gizzards with a gravel content of 0.8 to 4 cc contained, on the average, 3.5 cc of hard seeds. In stomachs with a below-average content of gravel—0.1 to 0.8 cc—the average of such seeds was 5.5 cc.

That gravel once taken into the gizzard may be retained over a lengthy period without having to be replenished daily is brought out quite clearly in the crop material examined. Only 8 of the 184 crops analyzed contained gravel, and 6 of these had merely a trace. This would indicate that gravel is certainly not picked up regularly with each meal, at least not during the season when the birds normally consume a considerable percentage of hard-seeded fruits.

WINTER FEEDING

Few game birds are better equipped to endure severe winter conditions than ruffed grouse. Though snow holds no terror for them, it greatly restricts their choice of food. Snow, however, is not likely to cause Virginia or West Virginia birds much hardship under average winter conditions, providing there is an adequate variety and abundance of shrubs and trees from which they can obtain buds and catkins (figs. 29 and 30). Among the species that supply such food are blueberries and huckleberries, menziesia, hazelnut, serviceberry, rhododendron, birch, hophornbeam, and apple. Other important foods that enable the



B48679

FIGURE 29.—Small glade, a forest type frequented extensively by ruffed grouse because of the variety and abundance of herbaceous food material to be found there.

birds to survive the ravages of the winter elements are greenbrier, mountain-laurel, rose, and hawthorn.

The weather conditions that the adult ruffed grouse find most difficult are prolonged sleet storms. Not only do such storms often have a directly injurious effect on the birds, but frequently they seriously restrict the availability of food. Heavy coatings of ice over food plants make feeding difficult and at times impossible. Such conditions extended over periods of several days may be disastrous to the birds. The southern and eastern slopes are the first to thaw after

ice storms, and thus are most suitable for the grouse during severe winter weather.

The nature of the food habits of ruffed grouse makes it difficult to supply food to them during emergency periods. They will accept corn, as evidenced by the record obtained from stomach examination, but are slow to become accustomed to it. As a rule, in satisfactory habitat they pull through the winter sieges unaided and without serious consequences. Emergency winter feeding is therefore neither so necessary nor so helpful to ruffed grouse as it is to quail, turkeys, and other upland game birds.

SUMMARY

A preliminary economic study by the Bureau of Biological Survey to provide a scientific basis for forest-game management on the George Washington National Forest, Va. and W. Va., disclosed that 20 plants



B48881

FIGURE 30.—Deciduous forest, with inadequate evergreen cover, a type of low value as winter range for ruffed grouse.

are outstanding sources of food for ruffed grouse early in winter. These plants furnished about 85 percent of the contents of 185 stomachs collected, chiefly by hunters, in November and December of 1935 and 1936. Herbaceous plants supplied about a third of the food, shrubs and vines each about a fourth, and trees the remainder.

The habitats of these 20 food plants also were studied. The results, in tables and graphs, show that wooded areas with open canopies and with soils sufficiently productive for the growth of mixed stands of shrubs and vine thickets furnish the best feeding grounds.

The early winter food plants, which are probably equally useful to grouse throughout the winter, are illustrated in normal winter condition for purposes of identification. This will be of assistance in setting up C. C. C. projects for improving grouse habitats in this and adjacent forests, as the winter appearance of the plants is quite different from their showy appearance in summer.

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